



# Automation Syntax & Program Development

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1891 N. Gaffey St. Ste. E  
San Pedro, CA 90731

p. 310.241.2973

[support@ctekproducts.com](mailto:support@ctekproducts.com)  
[www.ctekproducts.com](http://www.ctekproducts.com)

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# Programs

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Programs are named groups of functions that can be applied to a specific input or output as the result of a threshold event on an input or output. For instance, a program called *Power Indicator OFF* could be used to turn off an indicator whenever charging power is removed from a battery powered system. The same program could also set the application status to yellow on the SkyCloud display. Programs are assigned names that are made available in the program pull-down field of the input and output configuration screens. To create, modify, or delete a program select the Program option on the Automation Control screen (**Admin Main > Applications > Automation Configuration > Programs**).

# Functions

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Functions are predefined building blocks used to build user programs.

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## Function List

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Digital I/O – Set	Timer/Counter – Start
Numeric I/O – Set	Timer/Watchdog – Start
Hex I/O – Set	Timer/Clock – Start
Hex I/O - Set Bits	Timer/Counter/Ext/Clk – Start
Hex I/O Clear Bits	Timer/Alarm Override - Start
Numeric I/O – Add	Timer/Any – Stop
Numeric I/O – Subtract	Motor Group Control
Numeric I/O – Multiply	Application Status – Set
Numeric I/O – Divide	Input Threshold – Set
Remote I/O - Set	Execute New Configuration
Remote Numeric I/O - Set	Geo-Fence - Set
Remote Hex I/O - Set	

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# Function Definitions

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In the following descriptions, P1, P2, P3, etc. are used to indicate positional parameters or arguments that must be specified when using functions. Each parameter or argument given to a function **must be separated by a single space**.

# Setting and Clearing Input/Output Pins

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## Digital I/O – Set

**P1: Destination pin type** - Digital [ i ]nput or [ o ]utput

**P2: Destination Digital pin number**

**P3: Source type** - Digital [ i ]nput or [ o ]utput or [ u ]ser defined

**P4: Source Digital pin number or user defined value**

Example: Set digital output pin 6 to ON (1)

Function: Digital I/O – Set

Parameters: o 6 u 1

## Numeric I/O – Set

**P1: Destination pin type** - Numeric [ i ]nput or [ o ]utput

**P2: Destination Numeric pin number**

**P3: Source type** - Numeric [ i ]nput or [ o ]utput or [ u ]ser defined

**P4: Source Numeric pin number or user defined value**

Example: Set numeric input pin 12 to value of numeric output pin 9

Function: Numeric I/O – Set

Parameters: i 12 o 9

## Hex I/O – Set

**P1: Destination pin type** - Hex [ i ]nput or [ o ]utput

**P2: Destination Hex pin number**

**P3: Source type** - Hex [ i ]nput or [ o ]utput or [ u ]ser defined

**P4: Source Hex pin number or user defined value**

Example: Set hex output pin 3 to hex value FFF

Function: Hex I/O – Set

Parameters: o 3 u FFF

## Hex I/O – Set Bits

Set Bits performs a Boolean OR of the absolute value specified in the source definition with the destination pin.

**P1: Destination pin type** - Hex [ i ]nput or [ o ]utput

**P2: Destination Hex pin number**

**P3: Source type** - Hex [ i ]nput or [ o ]utput or [ u ]ser defined

**P4: Source Hex pin number or user defined value**

Example: Input 7 has a value of A6, set it to E7

Function: Hex I/O – Set Bits

Parameters: i 7 u 41

## Hex I/O – Clear Bits

Clear Bits performs a Boolean AND of the 1's compliment of the absolute value specified in the source definition with the destination pin.

**P1: Destination pin type - Hex [ i ]nput or [ o ]utput**

**P2: Destination Hex pin number**

**P3: Source type - Hex [ i ]nput or [ o ]utput or [ u ]ser defined**

**P4: Source Hex pin number or user defined value**

Example: Output 1 has a value of E1, set it to 81

Function: Hex I/O – Clear Bits

Parameters: o 1 u 81

## Performing Arithmetic functions

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### Numeric I/O – Add

### Numeric I/O – Subtract

### Numeric I/O – Multiply

### Numeric I/O – Divide

**P1: Destination pin type - Numeric [ i ]nput or [ o ]utput**

**P2: Destination Numeric pin number**

**P3: Source type - Numeric [ i ]nput or [ o ]utput or [ u ]ser defined**

**P4: Source Numeric pin number or user defined value**

Example: Add 1200.77 to input pin 17 and place the result on output pin 17

Function: Numeric I/O – Add

Parameters: o 17 u 1200.77

Example 2: Multiple input pin 14 by input pin 15 and place the result on input pin 14

Function: Numeric I/O – Multiply

Parameters: o 14 u 15

# Setting I/O on Remote Ctek Controllers

Remote operations are those decisions and resulting actions that are distributed between two or more Ctek controllers in different physical locations connected over the cellular network. All remote operations are a single function providing the ability to remotely set the values of remote virtual input pins and all types of output pins, both physical and virtual. This approach allows decisions to be made at the site where the actually machinery will be turned on and off and therefore provides a high degree of reliability.

## Remote Digital I/O – Set

**P1: Remote IP Address of Destination**

**P2: Destination pin type - Digital [ i ]nput or [ o ]utput**

**P3: Destination Numeric pin number**

**P4: Source type - Numeric [ i ]nput or [ o ]utput or [ u ]ser defined**

**P5: Source Numeric pin number or user defined value**

**P6: Network Wait Time**

**[ 0 ] Do not wait for network; assume that the network is available and initiate the remote operation which will succeed if an address is available or fail if it is not**

**[ 1 ] Wait for a certain period of time for the Ctek controller to get an IP address from the network**

Example: Set input pin 24 of IP address 166.155.12.12 to 1 after waiting for the network to respond (this means that we will change the value of input pin 24 on the remote unit using IP 166.155.12.12 to the user defined value of 1, after checking that the network is connected).

Function: Remote Digital I/O – Set

Parameters: 166.155.12.12 i 24 u 1 1

Example 2: Set output pin 18 at IP address 173.101.15.44 to the value of local input pin 4 without waiting for the network (this means that we will change the value of output pin 18 on the remote unit using IP 173.101.15.44 to the value defined by the local routers input pin 4, without checking if the network is connected).

Function: Remote Digital I/O – Set

Parameters: 173.101.15.44 o 18 i 4 0

## Remote Numeric I/O – Set

**P1: Remote IP Address of Destination**

**P2: Destination pin type - Digital [ i ]nput or [ o ]utput**

**P3: Destination Numeric pin number**

**P4: Source type - Numeric [ i ]nput or [ o ]utput or [ u ]ser defined**

**P5: Source Numeric pin number or user defined value**

**P6: Network Wait Time**

**[ 0 ] Do not wait for network; assume that the network is available and initiate the remote operation which will succeed if an address is available or fail if it is not**

**[ 1 ] Wait for a certain period of time for the Ctek controller to get an IP address from the network**

Example: Set input pin 5 of IP address 166.155.12.12 to 3.145 after waiting for the network to respond

Function: Remote Digital I/O – Set

Parameters: 166.155.12.12 i 5 u 3.145 1

## Remote Hex I/O – Set

**P1: Remote IP Address of Destination**

**P2: Destination pin type - Digital [ i ]nput or [ o ]utput**

**P3: Destination Numeric pin number**

**P4: Source type - Numeric [ i ]nput or [ o ]utput or [ u ]ser defined**

**P5: Source Numeric pin number or user defined value**

**P6: Network Wait Time**

[ 0 ] Do not wait for network; assume that the network is available and initiate the remote operation which will succeed if an address is available or fail if it is not

[ 1 ] Wait for a certain period of time for the Ctek controller to get an IP address from the network

Example: Set input pin 24 of IP address 166.155.12.12 to AF without waiting for the network to respond

Function: Remote Hex I/O – Set

Parameters: 166.155.12.12 i 24 u AF 0

## Timers and Counters

### Timer/Counter – Start

Timer/Counter is a value incrementing or decrementing at one second intervals. It is housed on a numeric input or numeric output. If it is in an output it is non-volatile and if it is in an input it is volatile. If it is in an output, the output can still be linked to an input. In either case the thresholds of an input can then be used to make decisions based on the counter value or the value can just be used to accumulate things like engine hours.

**P1: Destination pin type - Numeric [ i ]nput or [ o ]utput**

**P2: Destination Numeric pin number (location where the timer resides)**

**P3: Counter Type**

[ 0 ] Count up from current value

[ 1 ] Count up from user/pin defined value

[ 2 ] Count down from current value

[ 3 ] Count down from user/pin defined value

**P4: Start value source type - [ i ]nput or [ o ]utput or [ u ]ser defined**

**P5: Start value source pin number or user defined value**

**P6: Limit Type**

[ 0 ] No limit value

[ 1 ] Stop at user defined limit value

[ 2 ] Roll over to start value at user defined value and continue counting

**P7: Limit value (0 for no limit)**

**P8: Update value (amount to add/subtract each second)**

**P9: Write rate in 1 sec. increments (update frequency of timer value to P2)**

Example: Create a counter on output pin 14 that counts up from 0 in seconds with no limit and updates the display every 15 seconds

Function: Timer/Counter – Start

Parameters: o 14 0 u 0 0 0 1 15



## Timer/Watchdog – Start

A watchdog timer is a value decrementing at a one second rate. The value is NOT directly housed in an input or output pin. When the value decrements to zero the defined **digital** output or input pin will turn on. If you keep setting the watchdog timer, it will never get to zero.

**P1: Destination pin type** - Digital [ i ]nput or [ o ]utput

**P2: Destination Digital pin number (pin that goes high when the watchdog expires)**

**P3: Start value source type** - [ i ]nput or [ o ]utput or [ u ]ser defined

**P4: Start value source pin number or user defined value**

**P8: Update value (amount to subtract each second)**

Example: Set output pin 4 when a 60 second timer reaches 0

Function: Timer/Watchdog – Start

Parameters: o 4 u 60 1

## Timer/Clock – Start

A clock is a square wave signal generated on an input or output. It can be continuous or of a pre-defined pulse length. The clock frequency is generated by a decrementing counter. Each time the counter decrements to zero, the defined digital input or output will toggle state.

**P1: Destination pin type** - Digital [ i ]nput or [ o ]utput

**P2: Destination Digital pin number (location where the clock is generated)**

**P3: Clock rate source type** - [ i ]nput or [ o ]utput or [ u ]ser defined

**P4: Clock rate value source pin number or user defined value**

**P5: Update rate (decrement frequency in [Update rate] \* 0.1 sec. increments)**

**P6: Update value (amount to subtract from P4 each update period)**

**P7: Stop pulse value (Stop at defined number of pulses; Set P6 to 0 for continuous)**

Example: Clock output pin 1 at a rate of once every 1 second (1 second ON followed by 1 second OFF) for 400 iterations

Function: Timer/Clock – Start

Parameters: o 1 u 5 10 1 400

## Timer/Counter/Ext/Clk – Start

**Note:** Use of this function is tied to the Ctek controller's Discrete or Relay Input (pin 17)

Timer/Counter/Ext/Clk is a value incrementing or decrementing at the rate of the Discrete Input (DI) pin on the Ctek controller, also known as the relay input (pin 17). The Timer/Counter is assigned to a numeric input or numeric output. If it is in an output it is non-volatile and if it is in an input it is volatile. If it is in an output, the output can still be connected to an input. In either case the thresholds of an input can then be used to make decisions based on the counter value or the value can just be used to accumulate things like engine hours.

**P1: Destination pin type** - Numeric [ i ]nput or [ o ]utput

**P2: Destination Numeric pin number (location where the timer resides)**

**P3: Counter Type**

[ 0 ] Count up from current value

[ 1 ] Count up from user/pin defined value

[ 2 ] Count down from current value

[ 3 ] Count down from user/pin defined value

**P4: Start value source type** - [ i ]nput or [ o ]utput or [ u ]ser defined

**P5: Start value source pin number or user defined value**

**P6: Limit Type**

- [ 0 ] No limit value
- [ 1 ] Stop at user defined limit value
- [ 2 ] Roll over to start value at user defined value and continue counting

**P7: Limit value (0 for no limit)**

**P8: Update value (amount to add/subtract each input transition)**

**P9: Write rate in 1 sec. increments (update frequency of timer value to P2)**

**P10: Sample type**

- [ 0 ] Count transitions going negative
- [ 1 ] Count transitions going positive

Example: Count negative going transitions of the Discrete Input and place the count on output pin 17. The counter should count up from zero and has no limits. For each transition of the Discrete Input add 15 to the value of pin 17. Pin 17 will be updated every 30 seconds

Function: Timer/Counter/Ext/Clk– Start

Parameters: o 17 1 u 0 0 0 15 30 0

### Timer/Alarm Override – Start

Timer/Alarm Override – Start provides a mechanism to override (disable) all alarms for a specified period of time (in minutes). P1 and P2 define the pin that will represent the state of override, and P3 and P4 define the period of time for which alarms will be disabled. As with all timers Timer/Alarm Override is stopped with Timer/Any – Stop.

**P1: Destination pin type - Numeric [ i ]input or [ o ]output**

**P2: Destination Numeric pin number (location where override condition is represented)**

**P3: Override Duration (min.) source type - [ i ]input or [ o ]output or [ u ]ser defined**

**P4: Override Duration (min.) value source pin number or user defined value**

Example: Disable alarms for the number of minutes specified by input pin 11 and show override status on output pin 18.

Function: Timer/Alarm Override – Start

Parameters: o 18 i 11

### Timer/Counter/Any – Stop

Timer/Counter/Any – Stop will stop and of the counters/timers defined above.

**P1: Destination pin type - [ i ]input or [ o ]output**

**P2: Destination pin number (location where timer/counter is defined)**

Example: Stop a time previously started on output pin 5

Function: Timer/Counter/Any – Stop

Parameters: o 5

# Motor Control and Wear Leveling

Motor outputs (P3), Override inputs (P4), Hour Meter outputs (P5) require sequential assignment starting at the pin specified for the number of elements in the sequence. For example, a controller having 3 pumps might assign output pin 12 to be the starting pin for the first motor. This would automatically require that output pins 13 and 14 be the starting pins for motors 2 and 3 respectively.

Motor outputs (P3) must be configured so that their initial state is set to zero during automation control start up. All Override inputs (P4) must be configured to execute an override state change function when override pins turn on or off. This means that the override state change must be defined as both the “Off Program” and “On Program” on all override pins. All Hour Meter timers (P5) must be housed in outputs. The value of P5 will be interpreted as an output.

## Motor Control Group

Allows up to four motors to be controlled in a group where primary responsibility will alternate to ensure wear leveling. Hours of operation will be tracked in hours and tenths of hours.

### **P1: Function Type**

- [ 1 ] Start primary motor
- [ 2 ] Start secondary motor
- [ 3 ] Start tertiary motor
- [ 4 ] Start quaternary motor
- [ 5 ] Start all motors
- [ 6 ] Stop primary motor
- [ 7 ] Stop secondary motor
- [ 8 ] Stop tertiary motor
- [ 9 ] Stop quaternary motor
- [ 10 ] Stop all motors
- [ 11 ] Override state change

### **P2: Motor Count (Number of motor in the group)**

### **P3: Motor Start output source pin number; others assigned sequentially**

### **P4: Override Start input source pin number; others assigned sequentially**

**Note:** Override refers to a switch or signal to place the motor in service or take it out of service. When the motor is in service it operates automatically under the control of the Control\_Motor\_Group function. When it is out of service it is not available as a part of the group being controlled. A motor that is out of service can still be switched on and off manually but its state will be unknown to the Control\_Motor\_Group function.

### **P5: Hour Meter Start output source pin number; other assigned sequentially**

Example 1: Starting the primary pump at a pump station with two pumps starting on output pin 2 that are managed by override switches starting at input 4 and whose hours are tracked on outputs starting at output 6

Function: Motor Control Group

Parameters: 1 2 2 4 6

Example 2: Stopping all pumps at a pump station with two pumps starting on output pin 2 that are managed by override switches starting at input 4 and whose hours are tracked on outputs starting at output 6.

Function: Motor Control Group

Parameters: 10 2 2 4 6

# Application Status and Reporting to SkyCloud

The Application Status – Set mechanism requires that the number of events capable of producing an alarm state be defined. It also requires that each alarm event report its status once before the first application status change will be issued to SkyCloud. In terms of implementation, this means that each alarm event must have a corresponding alarm-clear event. The alarm-clear event should update *Application Status – Set* with a green status. Specifically, for a digital pin there needs to be a function with a program assigned to both the On and Off states of the pin, and for an analog/numeric pin there needs to be both an alarming threshold and a corresponding alarm clear threshold. In short, both an Alarm and an Alarm-Clear needs to be assigned to each pin that can generate an alarm.

## Application Status - Set

Application Status – Set provides a queuing and prioritization mechanism for Automation Control events/thresholds/states (Alarm States) that wish to change the application status color of the pin reporting to Ctek SkyCloud. Up to 10 different pins, each capable of changing the display to red, yellow, or green can be managed.

The prioritization mechanism insures that any red condition has the highest priority, followed by any yellow condition. The application status can only be green if no red or yellow inputs are being processed.

### **P1: Alarm Point ID**

A unique number between 1 and 10 that identifies an alarm point (pin) in an Automation Application. As an example a switch might be 1 and a temperature sensor might be 2.

### **P2: Status**

[ 0 ] Green

[ 1 ] Yellow

[ 2 ] Red

[ 3 ] Force Status Updates (causes an update of all values displayed on SkyCloud)

### **P3: Total number of alarm points in group**

### **P4: Alarm Group ID**

A single alpha-numeric character that is used by all alarm points in a single application. This parameter can have any value but must be the same for all alarm points.

Example 1: Set the application status of the SkyCloud pin representing your end point to red where there are 6 possible alarm points and you have assigned an ID of 3 to the specific alarm point that you are setting.

Function: Application Status – Set

Parameters: 3 2 6 A

Example 2: For the same application described in the previous example set alarm point ID 5 to Green

Function: Motor Control Group

Parameters: 5 0 6 A

Example 2: For the 2 examples above, use a force status update (P2: 3) to complete same task

Action: Application Status – Set

Parameters: 5 3 6 A

Or

Action: Application Status – Set

Parameters: 1 3 6 A

Or

Action: Application Status – Set

Parameters: 6 3 6 A

Note: Force status update is a special case that does not require a corresponding Alarm-Clear program and can use the Point ID (P1), Total Alarm Points (P3), and Alarm Group ID (P4) values of any the application.

## Managing Input Thresholds, Initial Values, and Initial Reference

### **Input Threshold - Set**

Input Threshold - Set allows the user to change a defined threshold, initial value or initial reference on an analog, pulse, or numeric pin under program control. When this function is executed, the permanent stored value for the selected parameter will be updated. If a threshold value is being updated, that value will immediately go into effect and thresholds will be reevaluated using the new value.

**P1: Destination** Numeric/Analog/Pulse **pin number**

**P2: Parameter to modify**

[ 1 - 17 ] **Threshold Number of Trigger**

[ 18 ] **Initial Value**

[ 19 ] **Initial Reference**

**P3: New Value source type** - [ i ]nput or [ o ]utput or [ u ]ser defined

**P4: New Value source pin number or user defined value**

**P5: Multiplier (Rest (Hysteresis) band multiplier for threshold trigger values; also, applied as a multiplier to Initial Reference or Initial Value)**

Example: Change a pressure threshold (threshold 4) on pin 12 to greater than 70 PSI with a 10% reset offset

Function: Input Threshold – Set

Parameters: 12 4 u 70 0.90

Example: Change the initial value of pin 12 to 100

Function: Input Threshold – Set

Parameters: 12 18 u 100 1.

## Managing Geo-Fences

### **Geo-Fence – Set**

The Geo-Fence Set function enables or disables a pre-configured geo-fence on the unit. Geo-fences are configured on the Ctek controller's Location Source screen and may be either assigned to automation control for use with this function, or operated from the web interface.

**P2: Fence to use**

[ 1 ] **Fence configuration 1**

[ 2 ] **Fence configuration 2**

**P2: Function**

[ 0 ] **Disable**

[ 1 ] **Enable**

Example: Enable fence configuration 2

Function: Geo-Fence – Set

Parameters: 2 1

# Restart the Application

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## Execute New Configuration

Produces, under program control the exact same effect as the Execute New Configuration button on the GUI screen. This function does not require any parameters.

**No Parameters**